What is claimed is:

1. An apparatus for virtually simultaneously transmitting data from a plurality of remote units to a central unit via a shared media using ATM cells and a virtual link across said shared media for each remote unit, comprising:

in each remote unit, a Segmentation And Reassembly circuit for receiving upstream data and generating therefrom a plurality of 48 byte ATM cell payload sections from said upstream data and adding header bytes identifying a virtual link ID assigned to the remote unit;

in each remote unit, a formatter circuit for receiving ATM cells from said Segmentation and Reassembly circuit and encoding them with start bits by which said central unit can locate the beginning and end of each ATM cell, and making the bytes of each ATM cell available for transmission to said central unit along with information for each byte as to which remote unit the byte originated and upon which virtual link each byte is to be transmitted;

in each remote unit, a multiplexing transmitter for obtaining bytes for transmission from said formatter and transmitting said bytes over said shared media to said central unit using multiplexing so as to establish a virtual link across said shared media between the remote unit and said central unit that is not shared by any other remote unit regardless of whether any other remote unit is virtually simultaneously transmitting data to said central unit, said transmission being such that all bytes from a particular remote unit are transmitted only on said virtual link associated with that remote unit.

2. The apparatus of claim 1 wherein said multiplexing transmitter is a synchronous code division multiplexing transmitter.

3. The apparatus of claim 1 wherein said multiplexing transmitter is a time division multiple access transmitter.

4. The apparatus of claim 1 wherein said multiplexing transmitter is a frequency division multiple access transmitter.

5. The apparatus of claim 1 wherein said multiplexing transmitter is a multitone transmitter which performs an inverse Fourier transform on one or more frequency components assigned to said virtual link assigned to said remote unit, and wherein said multiplexing transmitter includes circuitry to control the amplitude of

said one or more frequency components assigned to said remote unit's virtual link in accordance by the content of said upstream data originating from said remote unit, said inverse Fourier transform resulting in a composite signal which is summed with the composite signals from the multitone transmitters in all said other remote units for transmission over said shared media.

6. A process for virtually simultaneously transmitting data from a plurality of remote units to a central unit via a shared media using ATM cells and a virtual link across said shared media for each remote unit, comprising:

in each remote unit, receiving upstream data and generating therefrom a plurality of 48 byte ATM cell payload sections from said upstream data and adding header bytes identifying a virtual link ID assigned to the remote unit;

in each remote unit, receiving said ATM cells and encoding them with start bits by which said central unit can locate the beginning and end of each ATM cell, and making the bytes of each ATM cell available for transmission to said central unit along with information for each byte as to which remote unit the byte originated and upon which virtual link each byte is to be transmitted;

in each remote unit, obtaining bytes from each ATM cell for transmission and transmitting said bytes over said shared media to said central unit using multiplexing so as to establish a virtual link across said shared media between the remote unit and said central unit that is not shared by any other remote unit regardless of whether any other remote unit is virtually simultaneously transmitting data to said central unit, said transmission being such that all bytes from a particular remote unit are transmitted only on said virtual link associated with that remote unit.

7. The process of claim 6 wherein said transmission is by time division multiple access processing.

8. The process of claim 6 wherein said transmission is by frequency division multiple access processing.

9. The process of claim 6 wherein said transmission is by code division multiple access processing.

10. The process of claim 6 wherein said transmission is by multitone processing

using an inverse Fourier transform wherein each frequency component is modulated with the data of one virtual link.

11. A process for transmitting ATM protocol format cells over a CATV network providing point-to-multipoint coupling between a head end modem and a plurality of customer premises equipment (hereafter RU) modems for communicating with one or more peripheral devices coupled to each RU modem, comprising:

receiving data bytes from one or more data sources directed to a plurality of destination software processes in execution on a plurality of computing devices coupled to a plurality of destination RU modems;

converting said data so received into a plurality of ATM cells, each having payload data and a standard ATM cell header which includes a destination address identifying the destination software process to which the payload data is to be delivered, and each having a virtual link header which includes virtual link address data identifying the particular destination RU modem to which said ATM cell is to be delivered;

encoding the data in said ATM cells so that said destination RU modem can locate the beginning and end of each ATM cell directed to it by examining the data of the ATM cell itself;

encoding the data of each ATM cell with one or more synchronous code division multiplexing spreading code(s)(hereafter SCDMA code(s)) which are assigned to only the virtual link assigned to the destination RU modem of the particular ATM cell being so encoded, each of the SCDMA codes assigned to a particular virtual link being mathematically orthogonal to all the other SCDMA codes, all said SCDMA codes defining an SCDMA code matrix, so as to generate SCDMA encoded data for every ATM cell;

controlling modulation of one or more radio frequency carriers with said SCDMA encoded data to generate one or more RF signals carrying the data of all said ATM cells and transmitting said RF signals to all destination RU modems;

receiving and demodulating said RF signals in each destination RU modem to recover said SCDMA encoded data;

decoding said SCDMA encoded data using a decoding matrix which is the transpose of said SCDMA code matrix to recover all said ATM cell data in each destination RU modem;

decoding said recovered ATM cell data in each destination RU modem to locate the ATM cell boundaries in each said destination RU modem;

in each destination RU modem, comparing the virtual link address data in the virtual link header of each said ATM cell to the virtual link number assigned to that particular destination RU modem, and, in each destination RU modem, discarding any ATM cell not addressed to that particular RU modem;

in each destination RU modem, examining the destination address data in each ATM cell not discarded which identifies the particular destination software process to which the ATM cell is directed, disassembling the ATM cell and transmitting the payload data of the ATM cell to the destination software process to which the payload data is addressed.

12. A process for transmitting ATM protocol format cells over a CATV network providing point-to-multipoint coupling between a head end modem and a plurality of customer premises equipment (hereafter RU) modems for communication between one or more peripheral devices coupled to each RU modem and said head end modem, comprising:

receiving at each of a plurality of RU modems data bytes from one or more data sources coupled to said RU modems, each data byte directed to one of a plurality of destination software processes in execution on a plurality of computing devices coupled to said head end modem;

at each said RU modem, converting said data so received into a plurality of ATM cells, each having payload data and a standard ATM cell header which includes a destination address identifying the destination software process to which the payload data is to be delivered;

at each RU modem, encoding the data in each of said ATM cells so that said head end modem can locate the beginning and end of each ATM cell by examining the data of the ATM cell itself;

at each RU modem, encoding the data of each ATM cell generated at said RU modem with one or more synchronous code division multiplexing spreading code(s)(hereafter SCDMA code(s)) which are assigned to only the virtual link assigned to that RU modem, each of the SCDMA codes assigned to a particular virtual link being mathematically orthogonal to all the other SCDMA codes used by other RU modems to encode the data of ATM cells generated at said other RU modems, all said SCDMA codes used at all said RU modems defining an SCDMA code matrix, said encoding at each RU modem generating SCDMA encoded data at each RU modem for every ATM cell generated at said RU modem;

at each RU modem, controlling modulation of one or more radio frequency

carriers with said SCDMA encoded data generated at that RU modem to generate one or more RF signals carrying the data of all said ATM cells generated at said RU modem, and combining all said RF signals generated at all RU modems for transmission on said CATV network to said head end modem;

receiving and demodulating said combined RF signals at said head end modem to recover said SCDMA encoded data generated at all said RU modems;

decoding said SCDMA encoded data at said head end modem using a decoding matrix which is the transpose of said SCDMA code matrix so as to recover all said ATM cell data;

at said head end modem, decoding said recovered ATM cell data to locate the ATM cell boundaries of each ATM cell;

at said head end modem, examining the destination address data in each ATM cell which identifies the particular destination software process coupled to said head end modem to which the ATM cell is directed, and disassembling each ATM cell and transmitting the payload data of the ATM cell to the particular destination software process to which the payload data is addressed.

13. A process for transmitting ATM protocol format cells over a CATV network providing point-to-multipoint coupling between a head end modem and a plurality of customer premises equipment (hereafter CPE) modems for communicating with one or more peripheral devices coupled to each RU modem, comprising:

receiving a first plurality of data bytes from a first data source coupled to said head end modem in the form of 8-bit bytes which are directed to a particular peripheral device coupled to a first RU modem or are directed to a particular software process in execution on a computer coupled to said first RU modem (hereafter referred to as the first destination device or process), said data containing destination address information identifying the address of the first destination device or process;

receiving a second plurality of data bytes from a second data source, which may or may not be the same as said first data source, and which is coupled to said head end modem in the form of 8-bit bytes which are directed to a particular peripheral device coupled to a second RU modem, which may or may not be the same RU modem as said first RU modem, or are directed to a particular software process in execution on a computer coupled to said second RU modem (hereafter referred to as the second destination device or process), said data containing destination address information identifying the address of the second destination

device or process;

composing a first downstream ATM format cell from said first plurality of data bytes received from said first data source, said first downstream ATM cell having a predetermined number of 8-bit payload data bytes and a predetermined number of 8-bit header bytes which includes destination address information composed from said destination address information in said first plurality of data bytes received from said first data source and identifying the address of said first destination device or process;

composing a second downstream ATM format cell from said second plurality of data bytes received from said second data source, said second downstream ATM cell having a predetermined number of 8-bit payload data bytes and a predetermined number of 8-bit header bytes which includes destination address information composed from said destination address information in said second plurality of data bytes received from said second data source and identifying the address of second destination device or process;

appending to said first downstream ATM cell a virtual link header containing one or more 8-bit bytes of virtual link address data identifying one or more logical channels comprising a virtual link between said head end modem and first RU modem to which the data of said first downstream ATM cell is directed (hereafter referred to as the first destination CPE);

appending to said second downstream ATM cell a virtual link header containing one or more 8-bit bytes of virtual link address data identifying one or more logical channels comprising a virtual link between said head end modem and second RU modem to which the data of said second downstream ATM cell is directed (hereafter referred to as the second destination CPE);

adding a 9th bit to each 8-bit byte in each of said first and second downstream ATM cells, and encoding a predetermined number of said 9th bits starting with the 9th bit of the first byte of said virtual link header byte or bytes of each of said first and second downstream ATM cells with a predetermined, unique start code to indicate where each of said first and second downstream ATM cells starts such that ATM cell boundaries can be determined at said first and second destination RU modems;

assigning one or more numbered timeslots defining a first set of timeslots occurring during a first frame of timeslots on a first time division multiple access bus (hereafter first TDMA bus), said first TDMA bus for transmitting a plurality of frames of data within said head end modem, each frame comprised of a

plurality of numbered timeslots each of which may contain data and including timeslots having numbers which correspond to said first and second set of timeslots, said first set of timeslots assigned to the one or more virtual links assigned to said first destination RU modem;

assigning one or more timeslots defining a second set of numbered timeslots of said first frame on said first TDMA bus, said second set of numbered timeslots assigned to the one or more virtual links assigned to said second destination RU modem and which may or may not be interleaved with the numbered timeslots comprising said first set of timeslots;

placing one or more of said 9-bit bytes defining said first downstream ATM cell in said one or more numbered timeslots of said first set of timeslots during said first frame, and continuing during second and subsequent frames to put sequential 9-bit bytes from said first downstream ATM cell in sets of numbered timeslots which correspond in timeslot numbers to said first set of timeslots until all 9-bit bytes of said first downstream ATM cell have been transmitted on said time division multiple access bus;

placing one or more of said 9-bit bytes defining said second downstream ATM cell in said one or more numbered timeslots of said second set of timeslots during said first frame, and continuing during second and subsequent frames to put sequential 9-bit bytes from said second downstream ATM cell in sets of numbered timeslots which correspond in timeslot numbers to said second set of timeslots until all 9-bit bytes of said second downstream ATM cell have been transmitted on said time division multiple access bus;

receiving the data in said first set of timeslots and encoding said 9-bit bytes in said first set of timeslots with one or more synchronous code division multiplexing spreading codes (hereafter SCDMA codes) defining a first set SCDMA codes which are assigned to the logical channel corresponding to said first destination RU to generate first SCDMA encoded data;

receiving the data in said second set of timeslots and encoding said 9-bit bytes in said second set of timeslots with one or more synchronous code division multiplexing spreading codes defining a second set SCDMA codes which orthogonal to said first set of SCDMA codes and which are assigned to the logical channel corresponding to said second destination RU to generate second SCDMA encoded data where said first and second SCDMA encoded data may or may not be interleaved, and wherein said first and second sets of SCDMA codes define at least part of a first code matrix;

using said first and second SCDMA encoded data to modulate one or more radio frequency carriers having center frequencies in a band of frequencies assigned to downstream traffic from the head end to the CPEs and combining the modulated radio frequency carrier signals so as to generate one or more downstream radio frequency signals;

transmitting said one or more downstream radio frequency signals to all said RU modems over said CATV system;

receiving and demodulating said one or more downstream radio frequency signals at each RU modem to recover said first and second SCDMA encoded data;

decoding said first and second SCDMA encoded data at said first destination RU modem using a second code matrix, said second code matrix being the transpose of said first code matrix so as to recover the data which was transmitted on said first TDMA bus during said first and second sets of timeslots and continuing this process during second and subsequent frames until all 9-bit bytes of said first and second ATM cells are recovered;

decoding said first and second SCDMA encoded data at said second destination RU modem using a second code matrix, said second code matrix being the transpose of said first code matrix so as to recover the data which was transmitted on said first TDMA bus during said first and second sets of timeslots and continuing this process during second and subsequent frames until all 9-bit bytes of said first and second ATM cells are recovered;

transmitting said 9-bit bytes of said first and second ATM cells in individual timeslots on a second TDMA bus located in said first destination RU modem to a cell timing recovery circuit in said first destination RU modem;

transmitting said 9-bit bytes of said first and second ATM cells in individual timeslots on a third TDMA bus located in said second destination RU modem to a cell timing recovery circuit in said second destination RU modem;

decoding said 9th bits of the 9-bit bytes of said first and second ATM cells in said first destination RU modem to recover the cell boundaries of said first and second ATM cells;

decoding said 9th bits of the 9-bit bytes of said first and second ATM cells in said second destination RU modem to recover the cell boundaries of said first and second ATM cells;

comparing in said first destination RU modem the virtual link address data in said virtual link headers of said first and second ATM cells to the virtual link number assigned to said first destination CPE, and discarding said second ATM cell

because of a mismatch of its virtual link address data to the virtual link number assigned to said first destination RU and stripping off said virtual link header of said first ATM cell;

comparing in said second destination RU modem the virtual link address data in said virtual link headers of said first and second ATM cells to the virtual link number assigned to said second destination CPE, and discarding said first ATM cell because of a mismatch of its virtual link address data to the virtual link number assigned to said first destination RU and stripping off said virtual link header of said second ATM cell;

transmitting said first ATM cell minus its virtual link header but still having a standard ATM cell header in Utopia format to a segmentation and reassembly circuit in said first destination CPE;

transmitting said second ATM cell minus its virtual link header but still having a standard ATM cell header in Utopia format to a segmentation and reassembly circuit in said second destination CPE;

in said first destination RU modem, comparing said destination address data in said standard ATM cell header of said first ATM cell to the destination addresses of the peripheral devices coupled to said first destination RU modem and any software processes in execution on computers coupled to said first destination RU modem so as to locate the destination device or process of said first ATM cell;

disassembling said first ATM cell and transmitting the payload data thereof to said destination device or process of said first ATM cell coupled to said first destination RU modem;

in said second destination RU modem, comparing said destination address data in said standard ATM cell header of said second ATM cell to the destination addresses of the peripheral devices coupled to said second destination RU modem and any software processes in execution on computers coupled to said second destination RU modem so as to locate the destination device or process of said second ATM cell;

disassembling said second ATM cell and transmitting the payload data thereof to said destination device or process of said second ATM cell coupled to said second destination RU modem.

14. A process of transmitting data addressed to different one of a plurality of remote nodes from a first node, said first node coupled to said remote nodes by a shared media, comprising:

receiving data at said first node addressed to various ones of said remote nodes;

assembling the data addressed to each said remote node into a packet having a data structure of any desired communication protocol, said packet including header data identifying the particular remote node to which said packet is addressed and encoding each packet with data from which the start and end of each packet can be determined;

transmitting each packet to the remote node to which it is addressed via a virtual link established over said shared media using code division multiple access spreading codes to spread the spectrum of each packet, each said virtual link established by assigning selected spreading codes thereto;

at each remote node, demultiplexing and recovering each packet and discarding any packets not addressed to the remote node.

15. A process for transmitting data received at a plurality of remote nodes to destinations coupled to said remote nodes through a central node and a shared transmission media, comprising:

at each remote node, receiving data addressed to various destinations, and assembling data addressed to a particular destination into one or more packets each having a data structure established per a communication protocol, each data packet having header information identifying the particular destination to which the packet is addressed, each packet also being encoded with data from which the start and end of each packet may be located;

transmitting each packet to its destination over a virtual link established over said shared transmission media using code division multiple access spreading codes to spread the spectrum of each packet, a selected one or more of said code division multiple access spreading codes being assigned to each virtual link;

at said central node, demultiplexing and recovering each packet and transmitting each packet to the destination indicated in the header thereof.

16. The process of claim 14 wherein said step of assembling the received data into a packet comprises the steps of assembling the data into industry standard ATM cells having header information which identifies the particular remote node to which the ATM cell is addressed.

17. The process of claim 15 wherein said step of assembling data addressed to each destination into one or more packets comprises the step of assembling data addressed to each destination into one or more industry standard ATM cells having header information which identifies the particular destination coupled to said central node to which said data is addressed.

18. The process of claim 14 wherein said step of assembling data into packets and encoding the packets with data from which the start and end of each packet can be derived includes the steps of assembling the data into standard 55 byte ATM cells and adding a 9th bit to at least some of said bytes and encoding said 9th bits with a start code from which the starting and ending byte of each ATM cell can be determined.

19. The process of claim 15 wherein said step of receiving data and assembling data into packets and encoding the packets with data from which the start and end of each packet can be located includes the steps of assembling the data into standard 55 byte ATM cells and adding a 9th bit to at least some of said bytes and encoding said 9th bits with a start code from which the starting and ending byte of each ATM cell can be determined.

20. A method of processing and transmitting digital data from one of a plurality first circuits to a single second circuit over a shared media in a physically distributed system, comprising:

in each first circuit:

receiving local area network (hereafter LAN) packets and adding unique marker bits to the front of said LAN packet to mark the start thereof to generate modified packets;

parsing each said modified packet into a plurality of ATM cell payloads having a plurality of first bit groups and adding a plurality of additional bits to each ATM cell payload to generate from each ATM cell payload a modified ATM cell payload, and encoding said additional bits with auxiliary data indicating where the start of each said modified ATM cell payload is and also at least indicating which ATM cell payload contains the last bytes of said LAN packet;

parsing said modified ATM cell payloads into individual second bit groups which may or may not be the same size as said first bit groups, and transmitting each of said second bit groups to a multiplexing transmitter in said first circuit;

receiving said second bit groups and transmitting said second bit groups to said second circuit over said shared media using multiplexing such that said

second bit groups are transmitted over said shared media on a virtual link assigned to said first circuit such that said shared media appears to said first circuit to be reserved for the sole use of said first circuit in transmitting to said second circuit even though other first circuits may be virtually simultaneously transmitting data to said second circuit on said shared media.

21. The method of claim 20 wherein said step of transmitting said second bit groups to said second circuit over said shared media using multiplexing comprises using code division multiple access multiplexing wherein one or more orthogonal spreading codes is assigned to each virtual link for a first circuit and said second bit groups of each first circuit are transmitted by spreading the spectrum thereof using said one or more orthogonal spreading codes assigned to the virtual link dedicated to said first circuit, and further comprising:

in said second circuit:

recovering said second bit groups of digital data transmitted from each of a plurality of first circuits by, for each first circuit, despreading the spectrum of received signals using an inverse code matrix which is the inverse of a code matrix used in said first circuit to spread the spectrum of said second bit groups, said code matrix in said first circuit comprising said orthogonal spreading codes assigned to said virtual link dedicated to said first circuit and reassembling said first bit groups from said second bit groups if said second bit groups are smaller than said first bit groups;

using said auxiliary data encoded into said additional bits added by said first circuit, locating the beginning of each said ATM cell payload and reassembling each ATM cell payload; and

using said auxiliary data and said unique marker bits to locate the boundaries of said LAN packet, reassembling each LAN packet transmitted from a particular first circuit from said reassembled ATM cell payloads transmitted from said first circuit.

22. The method of claim 21 wherein each said LAN packet has a LAN header and is encapsulated by CRC bits, pad bits and said unique marker bits and wherein said LAN packet encapsulates a wide area network format packet destined for a process or machine having an address in an address space of said wide area network, said wide area network packet including a wide area network header, and further comprising:

transmitting each said LAN packet to a routing process after stripping off

said LAN header, said CRC bits, said pad bits, and said unique marker bits;

in said routing process, receiving said LAN packet and stripping off said LAN header and examining said wide area network header to determine the address in said address space of said wide area network to which said wide area network packet is destined, and performing conventional routing process steps to transmit said wide area network packet to said address in said address space of said wide area network.

23. A method for transmitting data upstream from a plurality of customer premises equipment cable data modems (hereafter RUs), each RU coupled to one or more sources of data, said RUs coupled to a head end cable data modem (hereafter CU) over a shared transmission media, said CU being coupled to a router and a wide area network, said upstream data transmission accomplished using an ATM protocol and any multiple access multiplexing process which allows multiple RUs to transmit virtually simultaneously to said central unit without substantial interference between the transmissions of different RUs such that each RU appears to have a virtual link between itself and said CU which is not shared with any other RU, comprising:

at each RU:

receiving a plurality of LAN packets from said one or more sources;

adding predetermined LAN packet identifier bits identifying the packet as an LAN packet to the front of each said LAN packet;

adding a sufficient number of pad bits to each LAN packet prior to calculation of a predetermined number of CRC bits so as to make the total number of bits in said packet, counting said predetermined LAN packet identifier bits added to the front of each packet, the LAN packet itself, said CRC bits and said pad bits, equal to an integer number of cells, each cell comprised of 48 8-bit bytes, and inserting said pad bits into each said LAN packet just preceding said CRC bits to turn each LAN packet into an AAL5 sequence packet;

computing CRC bits on each LAN packet including said predetermined LAN packet identifier bits, said LAN packet and said pad bits, and appending said CRC bits to the end of each said LAN packet after said pad bits;

segmenting each AAL5 sequence packet into one or more optimized upstream ATM cell payloads, each said payload comprising 48 8-bit bytes;

adding a 9th bit to at least some of said 48 8-bit bytes in each ATM cell payload to generate a plurality of optimized upstream ATM cells, and encoding a

first predetermined plurality of 9th bits of each optimized upstream ATM cell with data which defines whether the cell is a normal cell, an idle cell for which the payload may be discarded or is the last cell in the AAL5 sequence packet, and encoding a second predetermined plurality of said 9th bits with a unique start code by which the start of each optimized upstream ATM cell can be determined, and receiving information identifying said virtual link assigned to this RU, said virtual link established using said multiplexing techniques which assign to the virtual link dedicated to said RU one or more spreading codes if code division multiplexing is being used, one or more frequencies if frequency division multiplexing is being used or one or more timeslots if time division multiplexing is being used to each, said one or more whatevers which are assigned to said virtual link being hereafter referred to as channels, said virtual link information indicating which channels to use for transmissions from this RU to said CU;

receiving said optimized upstream ATM cells, and parsing each optimized upstream ATM cell into smaller groups of sequential 9-bit bytes, one said smaller group per frame, the number of 9-bit bytes in each group being equal in number to the number of channels assigned to this RU's virtual link for the frame corresponding to said group;

transmitting each said group of sequential 9-bit bytes to said CU using the virtual link channels assigned to the RU;

and, at the CU:

receiving the modulated carrier(s) and recovering the 9-bit bytes that were sent by said RU and sending each 9-bit byte to a formatting process along with information indicating from which RU each said 9-bit byte was transmitted, and using said recovered 9-bit bytes to reconstruct said optimized upstream ATM cells comprised of 48 9-bit bytes transmitted from said RU by determining from said second plurality of 9th bits with which of said collected 9-bit bytes the 48 9-bit byte optimized upstream ATM cell starts and then, starting from that byte, concatenating 48 9-bit bytes from the collected 9-bit bytes in the same sequence in which they were sent by said RU and repeating this process for all 48 9-bit byte optimized upstream ATM cells sent by said RU; and

using information identifying the virtual link in which each ATM cell was transmitted to construct predetermined fields of a standard 5 byte ATM cell header, and using the virtual link information and the information encoded into said first plurality of 9th bits to reconstruct a standard 5 byte ATM cell header

for each optimized 48 9-bit byte upstream ATM cell so as to generate a plurality of 53 byte upstream ATM cells;

stripping off said 9th bits of each said 53 byte upstream ATM cell to generate standard 53 8-bit byte ATM cells, and transmitting said standard 53 8-bit byte ATM cells to a SAR process;

in said router coupled to said CU:

reconstructing AAL5 sequence packets by locating the packet boundaries by locating the 53 8-bit byte ATM cell which contains said predetermined LAN packet identifier bits and the 53 8-bit byte ATM cell indicated by a PTI field in the header thereof to be the last ATM cell into which said AAL5 sequence packet was parsed at said RU, and reconstructing said AAL5 sequence packet using these two ATM cells as the first and last groups of bytes in said AAL5 sequence packet after stripping off the 5 bytes of header information in each cell and using the sequence of all the 53 8-bit byte ATM cells between these first and last cells, minus the 5 byte header information of middle cells falling between said first and last cells, to comprise the middle portion of said packet;

using CRC bits in said AAL5 sequence packet to error check said packet and, if there are no errors, stripping off said predetermined LAN packet identifier bits, said CRC bits and said pad bits to leave a packet with a LAN header, an internet protocol IP header and a payload, and transmitting said packet to a routing process.

25. The method of claim 24 wherein said virtual link for each RU is established by assigning one or more orthogonal spreading codes of a code division multiplexing transmitter to the virtual link, and wherein the step of receiving said virtual link information in said RU includes the step of receiving the identities of the orthogonal spreading codes assigned to the RU's virtual link, and wherein the step of transmitting 9-bit bytes between the RU and CU using the RU's virtual link comprises the steps of spreading the spectrum of said 9-bit bytes using the orthogonal spreading codes assigned to the RU's virtual link and using the spread spectrum signals so generated to modulate one or more RF carriers which propagate across said shared transmission medium to said CU.

26. A method of transmitting digital data addressed to a particular one of a plurality of physically distributed first circuits from a single second circuit,

comprising:

receiving a LAN packet having a header including a destination address from which the particular first circuit to which said LAN packet is to be transmitted can be derived, and appending to the header thereof unique marker bits marking the beginning of said LAN packet to generate a modified packet;

parsing said modified packet into a plurality of ATM cell payload sections comprised of a plurality of first bit groups and using said destination address information and information regarding whether each ATM cell payload section contains the last data of said LAN packet to generate an ATM cell header which is appended to each ATM cell payload section which together comprise said LAN packet to generate an ATM cell, each ATM cell header containing destination address information and auxiliary information from which can be derived whether said ATM cell contains the last data of said LAN packet;

transmitting said ATM cells to a formatter process where a plurality of additional bits are added which are encoded with auxiliary data including cell status and start codes indicating ATM cell boundaries and where said ATM cell header of each ATM cell is reduced to fewer bits containing at least destination address data, said formatter process encoding said auxiliary data into said additional bits as well as encoding therein a start code from which can be derived the beginning of each ATM cell to generate optimized downstream ATM cells;

parsing said optimized downstream ATM cells into a plurality of component bit groups and transmitting said component bit groups to a transmission process;

using said component bit groups to modulate one or more radio frequency carriers and transmitting said modulated one or more RF carriers to said plurality of first circuits.

27. The method of claim 26 further comprising:

in a first circuit:

recovering said component bit groups from said modulated RF carriers and using said start codes encoded into said auxiliary data to locate the boundaries of said optimized downstream ATM cells and reassembling said optimized downstream ATM cells;

discarding any optimized downstream ATM cell having destination address data indicating said cell is not addressed to this first circuit;

reassembling said LAN packet by locating said LAN packet boundaries

marked by said predetermined unique marker bits in the data of said optimized downstream ATM cells and locating the last optimized downstream ATM cell in said LAN packet by locating said auxiliary information encoded into said additional bits and concatenating said optimized downstream ATM cells containing said predetermined unique marker bits and said auxiliary information and all the optimized downstream ATM cells therebetween after stripping said additional bits and said destination address data.

28. A method of transmitting digital data from a central unit to a plurality of distributed remote units each remote unit having assigned thereto at least one virtual link identifier, comprising:

in said central unit:

receiving a packet from a first network coupled to said central unit, said packet having a header including destination address data defining the address within the address space of said first network of a destination node coupled to a remote unit by a second network;

finding, in a table that maps addresses in the address space of said first network to addresses in the address space of said second network and to the virtual link identifier assigned to each said address in the address space of said second network, a destination address for said destination node in the address space of said second network which corresponds to said destination address data of said packet from said first network and to the virtual link identifier assigned to said destination address in the address space of said second network, and generating a second network header for said packet using said destination address in the address space of said second network and appending said second network header to said packet from said first network to generate a first modified packet;

adding unique marker bits to the beginning of said first modified packet to create a second modified packet;

adding a sufficient number of pad bits to create a third modified packet having a number of bits, counting CRC error detection bits to be calculated later and including all header and payload bits such that the total number of bits is sufficient in number to make the total number of 8-bit bytes in said third modified packet equal to an integer times 48;

calculating said CRC error detection bits and appending them to the end of said second modified packet to create said third modified packet;

parsing said third modified packet into an integer number of sequential 48

byte ATM cell payload sections and using said virtual link identifier assigned to the destination address of said packet in the address space of said second network and auxiliary data regarding which of said 48 byte ATM cell payload section so generated contains the last bytes of said third modified packet to generate standard 5 byte ATM cell headers and appending said standard 5 byte ATM cell headers to each 48 byte ATM cell payload section, the header of the last ATM cell made from said third modified packet including data in a PTI field thereof indicating that it is the last cell included within said third modified packet, and the header of each ATM cell including VPI/VCI fields that contain virtual link identifier data;

transmitting said ATM cells to a formatting process;

in said formatting process, optimizing the header of each ATM cell by stripping off all header information except a sufficient number of bits to uniquely identify the virtual link dedicated to the remote unit to which the ATM cells are addressed, hereafter referred to as the virtual link header, said virtual link header being generated from the VPI/VCI fields of each standard 5 byte ATM cell header to leave modified downstream 8-bit byte ATM cells and adding a 9th bit to at least some of the bytes of each modified downstream 8-bit byte ATM cell;

encoding a first predetermined plurality of said 9th bits of each modified downstream ATM cell with at least the last cell information formerly contained in a PTI field of each modified ATM cell's former 5 byte standard ATM cell header before optimization and encoding a second predetermined plurality of said 9th bits of each modified ATM cell with a start code to generate an optimized downstream ATM cell, said start code being the means by which the RU receiver can locate the start of each optimized downstream ATM cell;

parsing said optimized downstream ATM cells into sequential individual bit groups and using said bit groups to modulate one or more RF carriers, and transmitting said modulated RF carriers to all said remote units;

in each remote unit:

receiving said modulated RF signals in each remote unit and recovering said bit groups transmitted by said central unit;

reassembling said optimized downstream ATM cells by locating each optimized downstream ATM cell boundary by finding said start codes encoded in said 9th bits and concatenating the recovered bit groups starting from the beginning identified by said start code of each optimized downstream ATM cell;

examining the virtual link header of each optimized downstream ATM cell and discarding any cells that are not addressed to this remote unit;

using the remaining optimized downstream ATM cells to reassemble packets having the same structure and content as the third modified packets from which said optimized downstream ATM cells were generated by finding the boundaries of said third packet by locating in said optimized downstream ATM cells said predetermined unique marker bits and said last cell information;

using said error detection bits to error check said third modified packet; and

if the packet has no errors, retrieving said third modified packet, stripping off said predetermined unique marker bits and sending the remainder as a LAN packet on said second network to the destination node coupled thereto identified by the destination address data in said address space of said second network included in said second network header.

29. A method for transmitting data upstream from a plurality of customer premises equipment cable data modems (hereafter RUs or remote units), each RU coupled to one or more sources of data, said RUs coupled to a head end cable data modem (hereafter CU) over a transmission media, said CU coupled to a router, said upstream data transmission accomplished using an ATM protocol and synchronous code division multiple access (hereafter SCDMA), comprising:

at each RU:

receiving a plurality of LAN packets from said one or more sources;

adding predetermined LAN packet identifier bits identifying the packet as an LAN packet to the front of each said LAN packet;

computing CRC bits on each LAN packet and appending them to the end of each said LAN packet;

adding a sufficient number of pad bits to each LAN packet prior to calculation of said CRC bits so as to make the total number of bits in said packet, counting said predetermined bits added to the front of each packet, the packet itself, said CRC bits and said pad bits, equal to an integer number of cells, each cell comprised of 48 8-bit bytes, and inserting said pad bits into each said LAN packet just preceding said CRC bits to turn each LAN packet into an AAL5 sequence packet;

segmenting each AAL5 sequence packet into one or more optimized upstream ATM cell payloads, each optimized upstream ATM cell payload comprising 48 8-bit bytes;

adding a 9th bit to each of said 48 8-bit bytes in each ATM cell payload to

generate an optimized upstream ATM cell, and encoding a first predetermined plurality of 9th bits of each optimized upstream ATM cell with last cell data which defines whether the cell is a normal cell, an idle cell for which the payload may be discarded or is the last cell in the AAL5 sequence packet, and encoding a second predetermined plurality of said 9th bits with a unique start card by which the start of each optimized upstream ATM cell can be determined;

transmitting the optimized upstream ATM cells as a Utopia TDM stream to a formatter;

receiving at said formatter timeslot information for a frame in a virtual link assigned to this RU, said virtual link established using one or more CDMA spreading codes assigned to encoding data to be transmitted by this RU over the virtual link assigned thereto, said timeslot information defining the timeslots assigned to this RU for transmission of data during said frame;

receiving said Utopia TDM stream of optimized upstream ATM cells, and parsing each optimized upstream ATM cell into smaller groups of sequential 9-bit bytes, one group per frame, the number of 9-bit bytes in each group being equal in number to the number of timeslots assigned to this RU's virtual link for the frame corresponding to said group;

transmitting each said group to a synchronous code division multiple access (hereafter SCDMA) transmitter in said RU as a first TDM stream with one group per frame, said first TDM stream having a plurality of timeslots and comprising one of said 9-bit bytes from said smaller group transmitted to said SCDMA transmitter in one of said timeslots assigned to this RU's virtual link during;

receiving at said SCDMA transmitter the 9-bit bytes in the timeslots assigned to this RU in a frame, and spreading the spectrum thereof using spreading codes assigned to this RU's virtual link for said frame to generate spread spectrum data, and modulating said spread spectrum data onto one or more carriers and transmitting the resulting modulated carrier(s) to said CU;

and, at the CU:

receiving the modulated carrier(s) and recovering the 9-bit bytes that were sent by said RU and using said recovered 9-bit bytes to generate a second TDM stream which is a copy of said first TDM stream by having timeslots which correspond in number and assignment to various RU virtual links to the number and virtual link assignments of timeslots in said first TDM stream, and placing said 9-bit bytes transmitted by said RU into the same timeslots in said second

TDM stream they were in within said first TDM stream;

reconstructing an optimized upstream ATM cells comprised of 48 9-bit bytes transmitted from said RU by collecting 9-bit bytes from the timeslots of said second TDM stream assigned in each frame to said RU and determining from said second plurality of 9th bits of the collected 9-bit bytes with which of said collected 9-bit bytes the 48 9-bit byte optimized upstream ATM cell starts and then, starting from that byte, concatenating 48 9-bit bytes from the collected 9-bit bytes in the same sequence in which they were sent by said RU in said first TDM stream to said SCDMA transmitter in said RU and repeating this process for all 48 9-bit byte optimized upstream ATM cells sent by said RU; and

using information derived from which timeslots in said second TDM stream in which the 9-bit bytes of each optimized upstream ATM cell arrived to determine the logical channel in which each ATM cell was transmitted and using the logical channel information and the information encoded into said first plurality of 9th bits to reconstruct a standard 5 byte ATM cell header for each optimized 48 9-bit byte upstream ATM cell to generate 53 byte upstream ATM cells;

stripping off said 9th bits of each said 53 byte upstream ATM cell to generate standard 53 8-bit byte ATM cells, and transmitting said standard 53 8-bit byte ATM cells to a SAR process;

in said router:

reconstructing AAL5 sequence packets by locating the packet boundaries by locating the 53 8-bit byte ATM cell which contains said predetermined LAN packet identifier bits and the 53 8-bit byte ATM cell indicated by its PTI field to be the last cell in said AAL5 sequence packet, and reconstructing said AAL5 sequence packet using these two ATM cells as the first and last groups of bytes in said AAL5 sequence packet after stripping off the 5 bytes of header information in each cell and using the sequence of all the 53 8-bit byte ATM cells between these first and last cells, minus the 5 byte header information of these middle cells, to comprise the middle portion of said packet;

using CRC bits in said AAL5 sequence packet to error check said packet and, if there are no errors, stripping off said predetermined LAN packet identifier bits, said CRC bits and said pad bits to leave a packet with an LAN header, an IP header and a payload, and transmitting said packet to a routing process.

30. A method for transmitting data upstream from a plurality of customer premises equipment cable data modems (hereafter RUs or remote units), each RU coupled to one or more sources of data, said RUs coupled to a head end cable data modem (hereafter CU) over a transmission media, said upstream data transmission accomplished using an ATM protocol and synchronous code division multiple access (hereafter SCDMA), comprising:

at each RU:

receiving a plurality of Ethernet packets from said one or more sources;

adding predetermined Ethernet packet identifier bits identifying the packet as an Ethernet packet to the front of each said Ethernet packet;

adding a sufficient number of pad bits to each Ethernet packet prior to calculation of a predetermined number of CRC bits so as to make the total number of bits in said packet, counting said predetermined bits added to the front of each packet, the packet itself, said CRC bits and said pad bits, equal to an integer number of cells, each cell comprised of 48 8-bit bytes, and inserting said pad bits into each said Ethernet packet just preceding the spot where said CRC bits will be included so as to turn each Ethernet packet into an AAL5 sequence packet;

computing said CRC bits on each Ethernet packet and appending them to the end of each said Ethernet packet;

segmenting each AAL5 sequence packet into one or more optimized upstream ATM cell payloads, each optimized upstream ATM cell payload comprising 48 8-bit bytes;

adding a 9th bit to each of said 48 8-bit bytes in each ATM cell payload to generate an optimized upstream ATM cell, and encoding a first predetermined plurality of 9th bits of each optimized upstream ATM cell with last cell data which defines whether the cell is a normal cell, an idle cell for which the payload may be discarded or is the last cell in the AAL5 sequence packet, and encoding a second predetermined plurality of said 9th bits with a unique start card by which the start of each optimized upstream ATM cell can be determined;

transmitting the optimized upstream ATM cells as a Utopia TDM stream to a formatter;

receiving at said formatter timeslot information for a frame in a virtual link assigned to this RU, said virtual link established using one or more CDMA spreading codes assigned to encoding data to be transmitted by this RU over the virtual link assigned thereto, said timeslot information defining the timeslots

assigned to this RU for transmission of data during said frame;

receiving said Utopia TDM stream of optimized upstream ATM cells, and parsing each optimized upstream ATM cell into smaller groups of sequential 9-bit bytes, one group per frame, the number of 9-bit bytes in each group being equal in number to the number of timeslots assigned to this RU's virtual link for the frame corresponding to said group;

transmitting each said group to a synchronous code division multiple access (hereafter SCDMA) transmitter in said RU as a first TDM stream with one group per frame, said first TDM stream having a plurality of timeslots and comprising one of said 9-bit bytes from said smaller group transmitted to said SCDMA transmitter in one of said timeslots assigned to this RU's virtual link during;

receiving at said SCDMA transmitter the 9-bit bytes in the timeslots assigned to this RU in a frame, and spreading the spectrum thereof using spreading codes assigned to this RU's virtual link for said frame to generate spread spectrum data, and modulating said spread spectrum data onto one or more carriers and transmitting the resulting modulated carrier(s) to said CU;

and, at the CU:

receiving the modulated carrier(s) and recovering the 9-bit bytes that were sent by said RU and using said recovered 9-bit bytes to generate a second TDM stream which is a copy of said first TDM stream by having timeslots which correspond in number and assignment to various RU virtual links to the number and virtual link assignments of timeslots in said first TDM stream, and placing said 9-bit bytes transmitted by said RU into the same timeslots in said second TDM stream they were in within said first TDM stream;

reconstructing an optimized upstream ATM cells comprised of 48 9-bit bytes transmitted from said RU by collecting 9-bit bytes from the timeslots of said second TDM stream assigned in each frame to said RU and determining from said second plurality of 9th bits of the collected 9-bit bytes with which of said collected 9-bit bytes the 48 9-bit byte optimized upstream ATM cell starts and then, starting from that byte, concatenating 48 9-bit bytes from the collected 9-bit bytes in the same sequence in which they were sent by said RU in said first TDM stream to said SCDMA transmitter in said RU and repeating this process for all 48 9-bit byte optimized upstream ATM cells sent by said RU; and

using information derived from which timeslots in said second TDM stream in which the 9-bit bytes of each optimized upstream ATM cell arrived to

determine the logical channel in which each ATM cell was transmitted and using the logical channel information and the information encoded into said first plurality of 9th bits to reconstruct a standard 5 byte ATM cell header for each optimized 48 9-bit byte upstream ATM cell to generate 53 byte upstream ATM cells;

stripping off said 9th bits of each said 53 byte upstream ATM cell to generate standard 53 8-bit byte ATM cells, and transmitting said standard 53 8-bit byte ATM cells to a SAR process;

reconstructing AAL5 sequence packets by locating the packet boundaries by locating the 53 8-bit byte ATM cell which contains said predetermined Ethernet packet identifier bits and the 53 8-bit byte ATM cell indicated by its PTI field to be the last cell in said AAL5 sequence packet, and reconstructing said AAL5 sequence packet using these two ATM cells as the first and last groups of bytes in said AAL5 sequence packet after stripping off the 5 bytes of header information in each cell and using the sequence of all the 53 8-bit byte ATM cells between these first and last cells, minus the 5 byte header information of these middle cells, to comprise the middle portion of said packet;

using CRC bits in said AAL5 sequence packet to error check said packet and, if there are no errors, stripping off said predetermined Ethernet packet identifier bits, said CRC bits and said pad bits to leave a packet with an Ethernet header, an IP header and a payload, and transmitting said packet to a routing process.